time, appropriations for such work would not be needed: the Government need only to foster such investigations, give them a start, and when the work is well advanced, leave it to State and individual action. We leave to another occasion the needs of an investigation of disease-germs, plant-fungi, in connection with rust, smut and mildew, and of cattle diseases, and would say a word in reference to applied entomology. This work cannot be done by one or several entomologists confined the year around to the Agricultural Department at Washington, where there are no extensive field or garden crops and forests. There might be formed a national board of entomologists, who should investigate cotton, wheat and corn insects, those infesting field and grass crops, and our forest and shade trees. They should not all be required to live at Washington, but work where the material is at hand; they should, therefore, divide the subject among themselves, prepare special bulletins, final reports and manuals for the diffusion of a genuine knowledge of insects, of which there are probably from 50,000 to 100,000 species on this continent. Such work would, we believe, do an immense deal towards multiplying local observers, diffusing a knowledge of applied and scientific entomology among the masses, would develop the teaching of useful natural knowledge in the common schools, increase the number of scientific entomologists and general biologists, and would eventually place the sciences of botany and zoölogy upon the same level which they hold in other countries, and in the end add immensely to the natural resources of our soil and increase our national wealth.

—— The Academy of Natural Sciences of this city, has filled two more of the chairs, which it created four years ago, with competent professors. The two courses of lectures, on invertebrate palæontology, and mineralogy and stratigraphic geology, are an important acquisition to the educational facilities of the city, and will also serve to strengthen the scientific back-bone of the Academy. The institution is to be congratulated on having made such an important advance, and in having given such merited recognition to Messrs. Heilprin and Lewis.

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RECENT LITERATURE.

WALLACE'S ISLAND LIFE.[1]—After the publication of his work entitled, "The Geographical Distribution of Animals," Mr. Wallace devoted four years' additional thought and research in

[1] *Island Life or the Phenomena and Causes of Insular Faunas and Floras*, including a Revision and attempted solution of the Problem of Geological Climates. By ALFRED RUSSELL WALLACE. New York, Harper & Brothers, 1881. 8vo, pp. 522.

the same direction, with the result before us, a book rather more popular in its treatment of the general subject, and a little narrower in scope in those chapters confined to a discussion of the causes governing the peopling of the larger oceanic and continental islands. The result is a most interesting work, and one which will serve to maintain, if not greatly advance the general interest felt by naturalists in the general and attractive subject of the philosophy or explanation of the causes of the present geographical distribution of plants and animals.

The author attempts to explain the present distribution of life by reference to a complex of causes grouped as biological and physical. The biological causes are (1) the constant tendency of organisms to increase in numbers and to spread out, disperse and migrate; and (2) "those laws of evolution and extinction, which determine the manner in which groups of organisms arise and grow, reach their maximum, and then dwindle away, often breaking up into separate portions which long survive in very remote regions." The physical causes are (1) "geographical changes which at one time isolate a whole fauna and flora, at another time lead to their dispersal and intermixture with adjacent faunas and floras;" and (2) the changes of climate which have occurred in various parts of the earth. A good deal of space is devoted to the subject of geological climates and their causes, and this inquiry has led to an investigation of the mode of formation of stratified deposits, with a view to fix within some limits their probable age, also to obtain a rough estimate of the probable rate of development of the organic world; both of these processes being shown to involve, in all probability, periods of time less vast than have generally been thought necessary. These subjects are discussed in the author's clear, pleasing and popular style in the first part. And it is in this part that our readers will take the liveliest interest. The second part is an explanation of the phenomena presented by the floras and faunas of the chief islands of the globe.

Returning to the first part, among the more general results of modern science, which Mr. Wallace utilizes for his purpose, is the doctrine now gaining wide acceptance in Europe, and which had been taught by Dana and Agassiz years ago in this country, namely that of the general stability of continents; that the "grand features of our globe—the position of the great oceans and the chief land-areas—have remained, on the whole, unchanged throughout geological time." The continents have been built up mainly of shore deposits. "The general stability of continents has, however, been accompanied by constant changes of form, and insular conditions have prevailed over every part in succession." We shall refer farther on to this doctrine, and its vital influence on zoö-geography, a point apparently overlooked by Wallace and by most other writers on this subject.

Three chapters are devoted to the influence of the glacial epoch

on the climate of the globe, and to the question of past glacial epochs and their causes. Mr. Wallace while adopting generally Mr. Croll's views as to the causes of the glacial epoch, limits and modifies his views by pointing out the very different effects on climate of water in the liquid and solid state, and that without high land there can be no permanent snow and ice. He concludes that the "alternate phases of precession, causing the winter of each hemisphere to be in aphelion and perihelion each 10,500 years, would produce a complete change of climate only where a country was *partially* snow-clad; while, whenever a large area became almost *wholly* buried in snow and ice, as was certainly the case with Northern Europe during the glacial epoch, then the glacial conditions would be continued, and perhaps even intensified, when the sun approached nearest to the earth in winter, instead of there being at that time, as Mr. Croll maintains, an almost perpetual spring." He also opposes the views of Mr. Croll and others as to the existence of general glacial epochs in earlier times, and claims that "the geological evidence leads inevitably to the conclusion, that during a large portion of the Secondary and Tertiary periods, uninterrupted warm climates prevailed in the north temperate zone, and so far ameliorated the climate of the Arctic regions as to admit of the growth of a luxuriant vegetation in the highest latitudes yet explored." He accepts Croll's hypothesis that the glacial epoch began about 200,000 years ago.

Mr. Wallace although a Darwinian as such, is not so extreme in his demands of unlimited time for the action of natural selection as the majority of his school. He duly respects the claims of the mathematicians and astronomers that the earth's age is to be reckoned by tens of millions rather than by larger figures, and adopts Sir William Thompson's conclusion "that the crust of the earth cannot have been solidified much longer than 100,000,000 years;" and Professor Haughton's estimate that the time to be required to produce the maximum thickness of the stratified rocks of the globe (177,200 feet) at the present rate of denudation and deposition is only 28,000,000 years. Now these are only guesses, but yet are useful, as indicating the order of magnitude of the time required. Mr. Wallace therefore claims that "so far as the time required for the formation of the known stratified rocks, the hundred million years allowed by physicists is not only ample, but will permit of even more than an equal period anterior to the lowest Cambrian rocks, as demanded by Mr. Darwin."

"In the tenth edition of the Principles of Geology, Sir Charles Lyell, taking the amount of change in the species of mollusca as a guide, estimated the time elapsed since the commencement of the Miocene as one-third that of the whole Tertiary epoch, and the latter at one-fourth that of geological time since the Cambrian period. Professor Dana, on the other hand, estimates the Tertiary as only one-fifteenth of the Mesozoic and Palæozoic com-

bined. On the estimate above given, founded on the dates of phases of high eccentricity, we shall arrive at about four million years for the Tertiary epoch, and sixteen million years for the time elapsed since the Cambrian, according to Lyell, or sixty millions, according to Dana. The estimate arrived at from the rate of denudation and deposition (twenty-eight million years) is nearly midway between these, and it is, at all events, satisfactory that the various measures result in figures of the same order of magnitude, which is all one can expect in so difficult and exceedingly speculative a subject.

"The only value of such estimates is to define our notions of geological time, and to show that the enormous periods of hundreds of millions of years which have sometimes been indicated by geologists are neither necessary nor warranted by the facts at our command; while the present result places us more in harmony with the calculations of physicists, by leaving a very wide margin between geological time as defined by the fossiliferous rocks and that far more extensive period which includes all possibility of life upon the earth."

Another good point made by Mr. Wallace, and one to be commended to the consideration of ultra-conservative anti-evolutionists, is that the present condition of the earth is one of exceptional stability as regards climate, and that the result is an epoch of exceptional stability of species.

It will be seen by the extracts made and the general tone of this interesting work that the author has given us a calm, moderate and yet comprehensive survey of some of the most interesting problems of modern science.

Mr. Wallace not only discards some of the exaggerated hypotheses of well-nigh limitless geological periods, but also the far-fetched ideas of intercontinental bridges and temporary islands, which so excellent a biologist as Professor Huxley is fond of invoking even up to the present year, and of the hypothetical Lemuria of Haeckel, and has fully adopted the well-grounded view of the permanence of the present continents and ocean basins. To American geologists the origin of the North American continent from the Laurentian nucleus, and its gradual building up by sediments derived from the waste of its own rocks, is a familiar view. Keeping pace with this building up and extension of the continental land mass was the evolution of its flora and fauna, which have borrowed none of their features from the old world, though there may have possibly been an interchange of forms with the South American continent. It was not until near the close of the Tertiary, perhaps, that the American and Asiatic continents nearly met, and that it was possible for a slight interchange of forms to take place on the west, while possibly through Spitzbergen and other islands north of the European-Asiatic continent there may have been a slight interchange of forms. Simultaneous with the growth of the

American continent (considering North and South America for our purpose as one) the Europeo-Asiatic, African and Australian continents developed, with their characteristic assemblages of plants and animals.

We have been accustomed to teach for several years past, and have briefly stated the doctrine in our "Zoölogy"[1] that the different continents have been original distinct centers of distribution, and that analogous forms of life found in opposite continents have not necessarily been derived one from the other, but may have arisen through the influence of similar physical surroundings on different continents; in this way we would explain the origin of representative species. For example, the "Scandinavian" flora did not necessarily people America, but the flora now found in Northern and Arctic Europe probably originated over both Europe and America. The American opossums were not necessarily travelers from Australia by way of Europe, but more probably originated from the Mesozoic lands of North America. The American continent had its own marsupials, its own tapirs, its own Felidæ, Canidæ, horses, camels and monkeys, which independently evolved on American soil, while representative forms arose in Europeo-Asiatic lands. It seems to us that this view is a simple and natural one, in accordance with geological and palæontological facts. Did Mr. Wallace entertain similar views, it seems to us, he would find in such a reasonable theory a simple and ready explanation of many facts in zoö-geography which he now accounts for by extensive intercontinental migrations on a scale and extent which is opposed by many geological facts. This fact, as we regard it, of the independent evolution in different continents of representative genera and species, lies, it seems to us, at the basis of a rational explanation of many otherwise inexplicable problems. In the light of recent discoveries in American vertebrate palæontology and deep-sea explorations, the high antiquity and independent origin of our continental fauna as a whole seems well nigh proved. Of course, when we come to the glacial period, when the continents of America and Asia approached each other, there were possibly interchanges of species, and extensive migrations from north to south, with wide-spread extinctions, which renders the distribution

[1] Zoölogy for High Schools and Colleges. By A. S. Packard, Jr. New York, 1879. "The earth's surface may then be mapped out into general and special divisions. First, a tropical, temperate, and arctic or circumpolar fauna or realm; and, secondly, each continent may form a smaller subdivision or specific center—*i. e.*, the Europeo-Asiatic, the African, the Australian, and the South and North American regions, for each of these continental divisions have been peopled with types of animals which have been from the earliest geological times the original possessors of the soil, though they may have adopted members of each other's faunæ," p. 662. "It appears, then, that each continent has had from the first its distinct assemblage of life, and thus opposing continents, such as South America and Africa, have fundamentally different faunæ, because they have had a separate geological history." Ibid, p. 664.

of life in the northern hemisphere in the Quaternary so different from that of the Tertiary.

The only European naturalist, so far as we are aware, who has insisted on the independent origin of the different continental floras and faunas is Professor Carl. Vogt, in a recent article published in Westermann's Monatshefte, where he vigorously discusses the subject, and claims that the monogenists, or those who believe that different types have arisen from a single individual, are in the wrong; that different continents may have simultaneously produced representatives or similar species; and that we should not accept a single center of creation for all faunas.

Naturalists are again indebted to Mr. Wallace for an original work in a field which he has gleaned so successfully, bringing back to the storehouse of science a sheaf of genuine facts abounding with ripe inductions and containing but little chaff.

RECENT BOOKS AND PAMPHLETS.—I Diaspri della Toscana e I Loro Fossili. Memoria dell Dott. Dante Pantantelli. (Reale Accademia dei Lincei, 1879–80.) 4to, pp. 34, 1 plate. Rome, 1880. From the author.

Gli Strati a Congerie e le Marne Compatte Mioceniche dei Dintorni di Ancona. (Reale Accad. dei Lincei, 1878–79.) pp. 26, 3 plates. Rome, 1879.

Balenottera Fossile delle Colombaie presso volterra. (Reale Accad. dei Lincei, 1878–79.) pp. 8. Rome, 1879.

Breccia Ossifera della Caverna di Santa Teresa nel lato orientale del Golfo di Spezia. By Prof. G. Capellini. 4to, pp. 26, 3 plates. Bologna, 1879. From the author.

Remarks on Bathygnathus borealis. By Joseph Leidy, M.D. (Ext. from Journ. Acad. Nat. Sciences, Phila., Vol. VIII.) 4to, pp. 3. 1881.

Parasites of the Termites. By Joseph Leidy, M.D. (From Journ. Acad. Nat. Sci., Vol VIII.) pp. 25, 2 plates. 1881. From the author.

Descripcion de la Ciudad de Guadalajara por Mariano Barcena. 8vo, pp. 123. Mexico, 1880. From the author.

Naturforskeren Peter Wilhelm Lund. Af J. Reinhardt. 8vo, pp. 64. Copenhagen, 1880. From the author.

Revisio Piscium Cubensium por Don Felipe Poey. (Anal. de la Soc. Esp. de Hist. Nat., Tomo IX, 1880.) 8vo, pp. 19, 5 plates. From the author.

Is Darwin Right? or, The Origin of Man. By Wm. Denton. 12mo, pp. 193. Wellesley, Mass., 1881. From the author.

New and little known Reptiles and Fishes in the Museum Collections. By Samuel Garman. (From Bull. Museum Comp. Zool., Vol. VIII, No. 3.) pp. 8. 1881. From Alexander Agassiz.

Bulletin of the United States Geological and Geographical Survey of the Territories, Vol. VI, No. 1. 8vo, pp. 202. Washington, Feb. 26th, 1881. From the Survey.

A partial biography of the Green Lizard. By Sarah P. Monks. (From the Am. Nat., Feb., 1881.) pp. 4. From the authoress.

Archæopteryx macrura, an intermediate form between Birds and Reptiles. By Carl Vogt. pp. 22, 1 pl. From the translator.

Geological Survey of Canada. Report of Progress for 1878–1879. By A. R. C. Selwyn, director. pp. 380, plates and maps. Montreal, 1880. From the director.

Corals and Bryozoa of the Neozoic Period in New Zealand, By J. E. Tenison-Wood. (From Palæontology of New Zealand. Pt. IV.) pp. XVI, 34, 4 plates. Wellington, 1880. From the author.

On a Post-tertiary Fauna from the Stream-tin deposits of Blitong (Biliton). By Dr. K. Martin. (From "Notes from the Leyden Museum, Vol. III.) 8vo, pp. 6, Nov. 1880. From the author.